Review and Evaluation of Completion of the Vorotan-Arpa Diversion Tunnel

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Tunnel Purpose and Scope

The Tunnel will divert waters of the Vorotan River through the Arpa-Sevan complex to Lake Sevan.

- The Tunnel is 21 km long, extending from Spandaryan Reservoir to Kechut Reservoir on Arpa River.
- The Vorotan River would supply 165 million cubic meters of water to Lake Sevan.
- The existing Arpa-Sevan diversion supplies 240 million cubic meters of water to Sevan.
- The long term outflow of Sevan is planned to be limited to 370 million cubic meters/year.

Construction Status

- The Tunnel has been under construction since 1984.
- Work was halted for several years due to funding problems. Maintenance was continued and re-excavation restarted in mid-1999.
- The completion work includes:
  - 750 meters of excavation
  - 1 km of concrete lining
  - 8.7 km of floor concrete
  - 9.6 km of final grouting
  - Rehabilitation of deteriorated works.
- The current work is in very difficult natural conditions in the remaining 750 meters of un-excavated alignment. This area is composed of saturated clay/sand, resulting in very slow progress.

Completion Costs and Schedule

- The Ministry of Agriculture Report stated completion costs of $5.5 million, with completion in 2000.
- Ministry of Agriculture representatives provided verbal estimates at $8 to 10 million (more reasonable) with an 18 month completion schedule
- Even if appropriate funding is provided, the completion schedule is probably 18-24 months.
- Further, the costs and schedule for rehabilitation of the downstream Arpa-Sevan Tunnel are $8 million and 3 years, with construction stoppage for water diversion.

Operating Considerations

- Ministry of Agriculture represent report gives annual estimates at $140,000. This is likely a low figure.
- A Prior Study cited by World Bank in Lake Sevan Action Plan estimated costs at $1 million. This is likely a high estimate.
- No existing authority exists to balance water diversion priorities between Energy/Agriculture/Ecology. The Action Plan suggests Lake Sevan Commission be established.

Impact on Lake Sevan Water Level

- The Lake Sevan level has dropped 21 meters over about 60 years.
- A return to prior level not realistic, however 3-6 meters of increase is considered critical.
- With limits on release and additional diversion to Sevan, increase in level can be accelerated.

Increase of lake level:	3 meters	6 meters
Limiting releases to 370 million m^3/year	34 years	85 years
Construction of Vorotan-Arpa and limiting to 370 million m^3/year	15 years	37 years

- The current year estimate of water volume release from Lake Sevan is 197 million cubic meters.

Benefit Analysis of Vorotan Arpa Tunnel

- Costs of project include Capital Cost, Operating Cost, loss of 264 million kWh of generation at Vorotan Cascade, about 1/4 of average annual output.
- Ministry of Agriculture Report cited many downstream benefits including more irrigation, pumping savings, energy generation in Sevan-Hrazdan Cascade.
- Ministry of Agriculture analysis understated costs, overstated benefits and assumed 100 of 165 million cubic meters released downstream.
- IWACO Study showed completion costs not economically justified.
- Justification of the tunnel completion must be based on:
  - Protection of Lake Sevan Resource and Environment,
  - Maintenance of Lake Sevan as strategic water and energy storage device.

Environmental Considerations

- The benefits of raising Sevan Lake level well documented and obvious.
- The impacts to other areas have apparently not been studied.
- There are possible problems associated with the introduction of Vorotan River waters to both Arpa and Sevan ecological systems.
- There has been no impact assessment of water loss to Vorotan River ecosystem.

Institutional Considerations

- Vorotan River is an international water body, flowing east to Azerbaijan and to Araks River, which is the international border between Azerbaijan and Iran.
- Usually, diversion/consumption from international river subject to a treaty or understanding.
- International water law and convention regarding this particular project is not known at this point.
- Legal and water use assessments must be done before funding.

Completion Risks

- The Tunnel Project is subject to high risk for costs and completion schedule.
- There is a high risk of having additional funding spent, with the project remaining incomplete.
- There must be established a clear progress schedule and comprehensive cost estimate made for the whole Vorotan-Arpa-Sevan diversion program.
- Any fund disbursement should be made like a bank lending system, with release based on verified progress by independent party.

Summary of Findings

- Tunnel Project advanced in construction, but will be difficult to finish and in need of re-work in some areas:
  - completion cost likely to be $10 million,
  - schedule of 18-24 months,
  - in need of additional technology assistance.
- A delay in completion will increase costs due to deterioration of poor construction in completed sections.
- The Arpa-Sevan Tunnel is also in need of rehabilitation at estimated cost of $8 million.
- The Vorotan-Arpa Tunnel will have a clear positive impact on Lake Sevan level with proper management.
- The tunnel completion is not justified solely on the basis of downstream benefits from Lake Sevan.

Summary of Findings, continued

- Project completion must be justified on the basis of:
  - Preservation of Ecology of Sevan,
  - Strategic storage of water for emergencies.
- A full environmental assessment should be completed.
- International legal aspects of permanent water diversion must be considered.
- A comprehensive completion budget and schedule needs development/approval by independent parties.
- Fund disbursal should only be made on clear and independent verification of work progress towards completion.